Computers and Internet
CQ Magazine, March 2001
Don Rotolo, N2IRZ

Networking, but not Packet

If you have more than one computer in your house, this is for you. For my first column of the third millennium, we'll have a look at some of the advantages of setting up a computer network in your house, some details on the hardware and software you'll need, and a few tips on installation.

Most hams have at least one computer in their house or shack. In addition to using these computers for word processing and surfing the Internet, we also use them for logging contacts, controlling our radios, and even for making contacts in the various data modes, such as CW, Packet and PSK31.

Nowadays, we often have more than one computer, with the new one for the kid's games, and the older one(s) relegated to the shack. Wouldn't it be nice if we could connect those computers together? That way, we aren't tied to using a specific machine for a specific task.

The main advantage of interconnecting computers is the ability to share files and peripherals. For example, a printer can be used by anyone on the network. One computer - the one with the huge hard disk - can be designated as the file server, where all the large files are kept. That allows the old machine, with a 120 MB hard disk, to remain in service for a few more years. Perhaps the shack PC can be controlled from a warm spot in the family room. Don't forget the excitement of multi-player games!

This sharing of peripherals can be taken a step further, to include modems and other devices. Perhaps you have a DSL line or, like me, your cable TV company has just started offering cable modems for Internet access. Having megabit per second access is quite a lot of fun, but imagine if you could share that connection with the rest of the house.

Here are the essentials of how to do it. If you're really interested, read the Windows documentation, or buy a book. We're going to look at the relatively simple peer-to-peer networks, which are perfect for small networks. Larger networks need a client-server architecture, but these are way too complex and expensive for most homes.

Hardware

Let's look at hardware. First, the interface cards: Each computer on the network needs a *Network Interface Card*, or NIC (pronounced "nick"). These cost anywhere from $8 to over $50 for the really good ones, and support data rates of 10 or 100 MB/s (or both!). For now, I recommend getting the $15 kind, which support 10 MB/s - cheap enough, and can be upgraded later. Get NICs that have a 10BaseT (RJ-45) connector, shown in Figure 1, which is a wide (8-pin) telephone connector.

Wire comes in different types (duh!), but for computer "Ethernet" networks, two styles really dominate: RG-58 and UTP. RG-58, or ThinNet, is well known by hams as thin coaxial antenna wire, often used for mobile antennas, and supports the 10Base2 computer network standard. UTP, or *Unshielded Twisted Pair*, is 4 twisted pairs of 22 or 24 gauge wire, and it supports the 10BaseT and 100BaseT standards. Modern networks use UTP almost exclusively, which can be run for up to 300 feet.

In order to carry data at 10 or 100 MB/s, the wire and connectors must meet a stringent standard, known as *Category 5*. When buying wire, connectors, wall jacks, and other accessories, make sure they meet the Cat 5 standard. Don't skimp here. Regular Cat 5 has PVC outer insulation, but you can also get it with Teflon® insulation (known as Plenum grade), which allows you to run it inside heating and air conditioning ducts, since Teflon doesn't burn easily. Building codes may require plenum cable inside walls as well - check first.

To connect all these computers together, you use a *Hub* or a *Switch*. Both are small devices into which the wires from the computer NICs are connected, and come in 10 Mb/s and 100 Mb/s types, sometimes supporting both speeds. The difference is that with a hub, the 10 Mb/s data capacity is shared with all the computers on the network, while a switch speaks to each computer separately, allowing the full speed for each computer. Again, I recommend a relatively inexpensive Hub (Figure 2), with 5 to 8 ports, as this will perform adequately in a home network, for about $50.

If you want to share a cable, ISDN or DSL line (so-called *Broadband* line) on your network, you need some kind of security, so others cannot access your network. Using a *Router* ensures that others don't have access to your network unless you specifically permit it. This security function is also called a *Firewall*, and is essential if you're connected to the outside world.. A good quality router, which looks to the broadband line like a single computer with no file or peripheral sharing enabled, costs about $100 or so. The other side of the router is connected into your network, where all the computers have access to it. You can also get routers with hubs built in, as well as dial-up routers with a built-in 56k modem, for plain old dial-up connections. The Firewall can also be done in software, requiring a computer with two NICs, but hardware routers are so reasonably priced, they are a more reasonable solution.

Software

Now we have to think about software, since the hardware is useless without it. Networking software is sold by Novell, IBM, and others, but if you're running Microsoft Windows version 3.11 or later, you already have a simple peer-to-peer network application: Microsoft Networks (Also called Windows for Workgroups).

The main disadvantage of Microsoft Networks is it's relative simplicity, which allows only file, printer and Faxmodem sharing. If you want to share a data modem, TNC or other device, you'll need to find software or hardware (like a router!) for that task.

However, it is really simple to set up and maintain, supports a wide variety of hardware and remote dial-up access, and best of all, it's included with Windows for free!

While other networking software can support advanced applications better, these networks are quite complex to set up and maintain. Of course, if you take this as a learning experience, and really figure out how to care for and feed a Novell 4.x network, you can get a new job with a 6-figure salary just about anywhere in the country.

I would be negligent if I didn't mention three alternatives to running a wired network: Wireless, Phone wire, and Power Line devices. Wireless uses Part 15 radios, phone wire devices use the existing phone wires, and the power line devices use your house's AC wiring. These are not any less costly, nor are they fast, and there are concerns about the security of your data for wireless and power line devices. But, if you cannot or will not run new wires, they remain an option.

Wiring

Running the wires is easier than it sounds. I'll assume you live in a typical American house, which is wood-framed with only two stories and a basement or crawlspace beneath. If you live in Europe, you already know about running wires in solid masonry walls (you can't), and if you live in an apartment, you might need to develop some alternative strategies.

Plan where the computers and hub (and/or switch/router) will go. The hub should be centrally located, to minimize wire runs, and near a source of AC power. You can use more than one hub if it makes it easier, simply connect them together with another wire.

Before you start, remember some safety rules: Drills and AC Power wiring or water pipes inside walls don't co-exist well. Make sure you know what you're drilling or cutting into. Keep all networking wires well away from AC Power wiring, and never, ever, allow them into the same enclosure or wall box. Contact a qualified electrician if you're not sure - they do this for a living, and your life might be worth it.

Pick out where the Cat 5 wall plate with an RJ-45 socket in it will go, avoiding any wood studs or other obstacles in the wall. Drill or cut a hole (as large as possible, but small enough to be covered by the wall plate - say, 2" by 3") into the gypsum wallboard or plaster wall. Now, locate the spot beneath (or above, from the attic) the center of the wall, and drill a 3/4" hole through the 'plate' into the wall cavity. See Figure 3.

Push an electrician's fish tape (or a straightened coat hanger) through the 3/4" hole up to the cutout in the wallboard. Using your hand, or another piece of wire, snag the fish tape and pull it out the hole in the wall. Tape the UTP to the end, and gently pull it back through and into the basement. From the attic, you might try just feeding the UTP into the 3/4" hole and letting it drop down to the hole in the wall, and snag it directly. Pull the wire all the way to the hub, and leave a few feet of slack.

Finish by installing the RJ-45 connectors onto the wire (or buy cable with the ends already attached - a good idea, in my book), and mounting the wall plates. Plug all the wires into the hub and connect the power.

The Last Bit

Lastly, tell each computer that it needs to consider the network: In Windows 95 and later, networking can be plug-n-play, or you can click on the Network icon in the Control Panel. In Windows 3.11, run Setup in the Windows folder to set up the Network. It is best to use the drivers supplied with your NIC, but Windows supports many common types as well.

That's really all there is to it. Each computer sets the permissions for file and printer sharing that others in the network have. I suggest playing with it a while before getting into the advanced features, like remote dial-up access (which lets you dial into your network from afar).

That's all the space we have this time. In next June's issue of CQ, we will talk about how to build a new computer, including some thoughts about selecting the parts. Also, a note of Thanks to everyone who has written with questions, comments, suggestions and ideas for future columns. For the rest of you, please remember that this is a two-way, fully interactive column: don't hesitate to write, it's always a treat to hear from readers. Until next time - 73 de N2IRZ.

Resources:

Just about any question you may have about networking is answered at the Practically Networking site, <http://www.practicallynetworked.com/sharing/sharingcable.htm>.

Linksys makes hardware for networking, and their small routers and hubs are of good quality and are reasonably priced. Their networking tutorial at <http://www.linksys.com/faqs/default.asp?fqid=15> is worth a visit.

My hub is made by Addtron, it was very inexpensive and works well. <http://www.addtron.com>

Netgear is yet another networking hardware supplier who comes highly recommended. <http://www.netgear.com>

Illustrations & Photos

Fig 1: A male (left) and female (right) RJ-45 connector. This is the same connector as used in many newer radios for the microphone connection. Note the 'snagless' boot on the male connector, which prevents the release tab from snagging on objects as you pull the

wire through walls. For computer networking, be sure to use wire, connectors and accessories certified to meet the Category 5 standard.

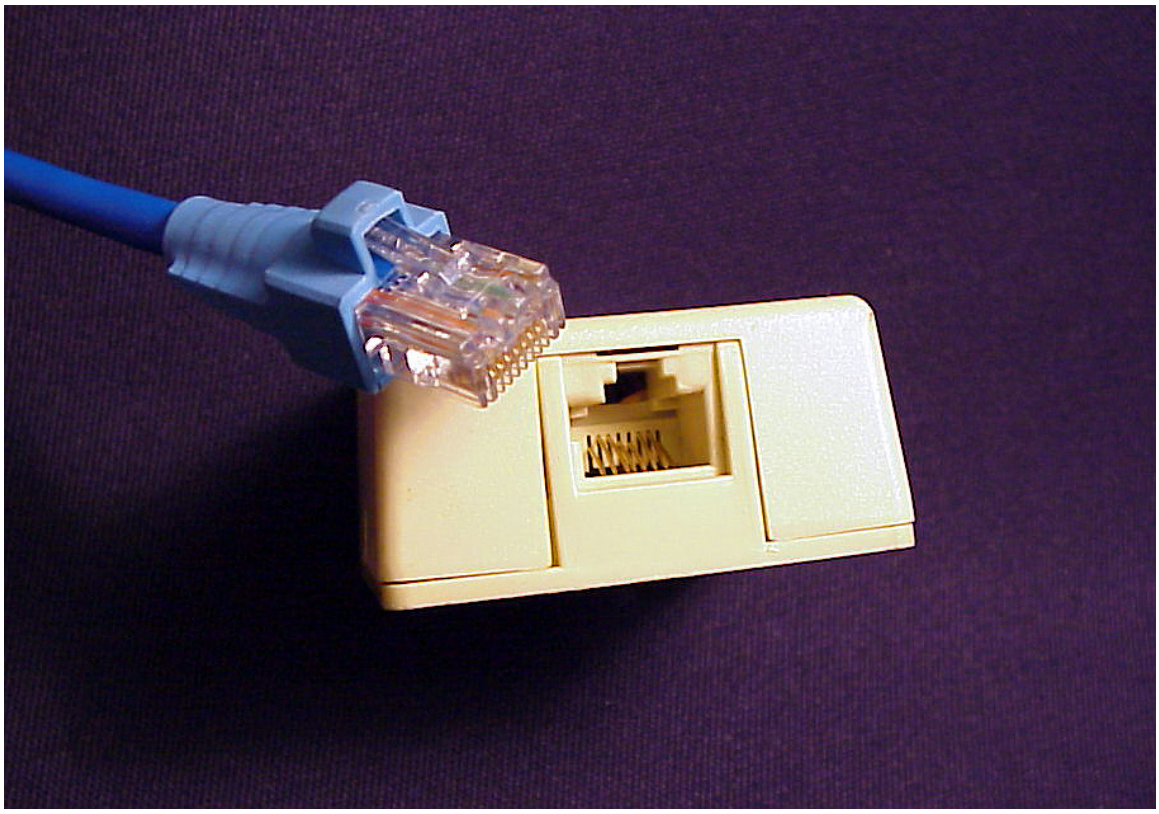

Fig 2: An 8-port 10BaseT hub used by the author. This hub cost only $55 and has been in use for 3 years. At the rear, there are eight RJ-45 jacks. On the front panel, shown, there is a BNC connector for ThinNet and a 15-pin Sub-D AUI connector. These two extra connectors allow older networking equipment to connect into the hub. Also note the eight 'Link Status' LEDs, one for each port, and the power jack.

Fig 3: Typical stud frame construction. Running a new wire inside a wall isn't as hard as it looks. Cut a small hole into the wallboard (later covered by a wall plate), and drill a hole into the bottom or top plate from the basement or attic. Use a coat hanger to fish the new wire through both holes. See the text for important safety notes.

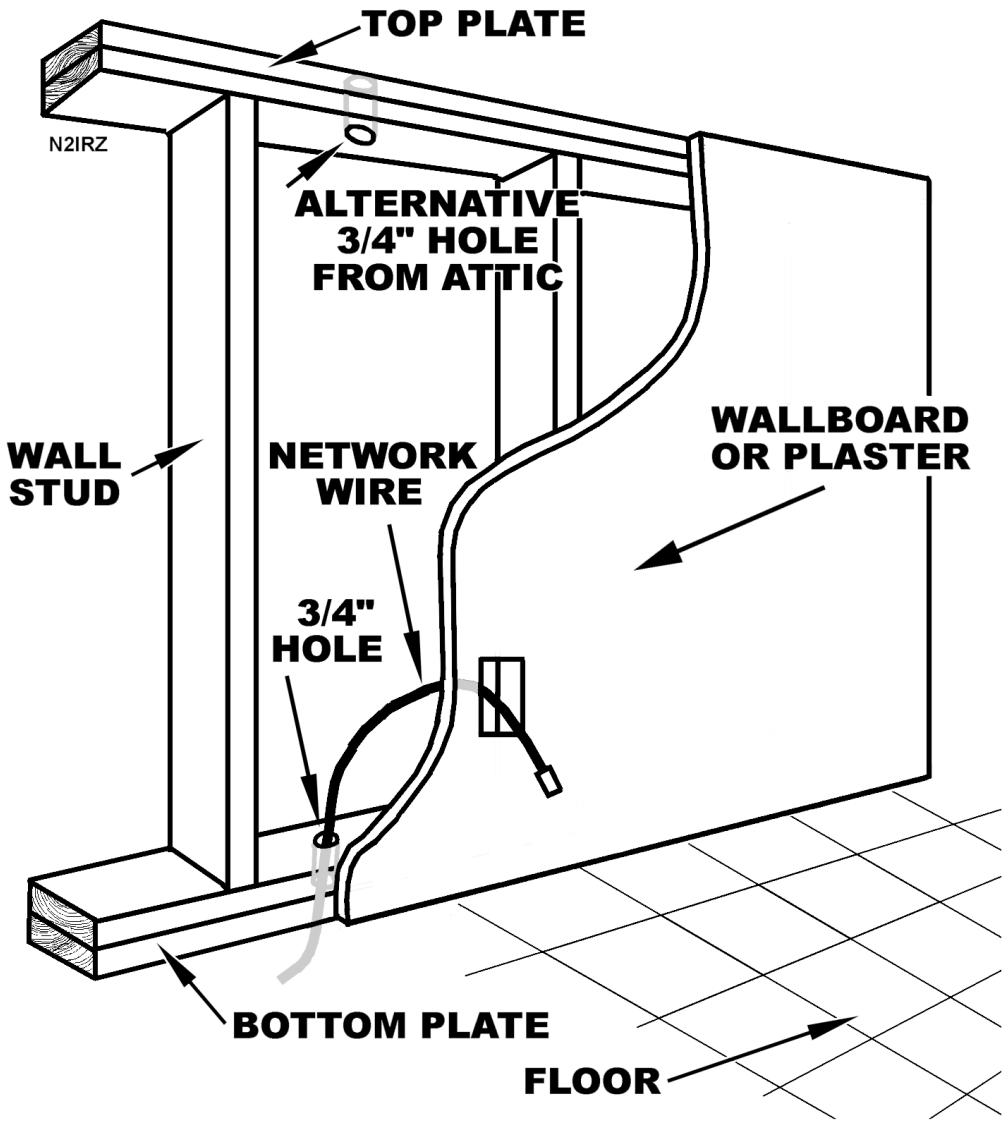

Fig 4: Proper 10BaseT/RJ-45 cable wiring assignments. When using a hub, use this wiring configuration. Note that four of the wires are not assigned, and can be used for your regular telephone line, or other purposes, if you like.